

### **AMENDMENTS TO THE SPECIFICATION**

Please replace these paragraphs with the following paragraph rewritten in amendment format:

**The paragraphs beginning on Page 4 at Line 5:**

FIGURE 6 is a graph illustrating the number of satellites observed per hour at the predetermined geographic location after incorporating the method of the present invention; [[and]]

FIGURE 7 is an equirectangular view of the projection of the orbit planes on the surface of the earth for the specific satellite constellation after incorporating the method of the present invention; and

FIGURE 8 is a flow diagram illustrating a second sequence of steps associated with a method of the disclosure.

**The paragraph beginning on Page 5 at Line 1:**

Turning now to ~~Figure~~ Figures 3 and 8, the general steps associated with the method of the present invention are illustrated. First, a desired satellite constellation is determined, as shown at block 20 (block 50 in Figure 8). For example, it may be desirable to design a satellite constellation providing global coverage at all times. Thus, it may be desirable to use five satellites in two planes to provide such global coverage. It is also desirable to have the two planes be more uniformly spaced over the globe. If the desired geographic location is the border of Spain and France, the latitude is 40° N while the longitude equals 0°. The inclination angle of each of the satellites may be 45°. If the desired geographic location is Los Angeles, which is near longitude equal to 120°, the ascending nodes would be 60° and 120° correspondingly.

**The paragraph beginning on Page 5 at Line 23:**

Next, the period of rotation of each of the satellites is determined, as shown at block 22 (block 52 of Figure 8). If the point of interest (predetermined geographic location) and the orbit are near the equator, i.e., latitude equals  $0^\circ$ , the orbital period is determined as follows:

$$P = [m_s D_s D_N / (n D_N + m_s D_s)], \quad (\text{Eq. \#1})$$

where,

P is the orbit period with its sign indicating whether it is a direct or retrograde orbit;

n is an integer with its absolute value equal to the number of times that the satellite transverses the same geographic longitude within the repeating period;

$m_s$  is the number of mean solar day per repeating period and must be a positive integer relatively prime to n;

$D_s$  is the mean solar day, which is 24 hours or 1440 minutes; and

$D_N$  is the nodal day which is the period of the earth-rotation relative to the ascending node or any point of the orbit plane. If the orbit plane does not rotate in the inertial frame, it is the same as the sidereal day  $D_1$  which is about 1436 minutes.

**The paragraph beginning on Page 7 at Line 13:**

Knowing the period of the satellite constellation, the time dependent coverage provided by the satellites can then be determined, as shown at block 24 (block 54 of Figure 8), utilizing simulation or other similar analysis. Referring again to the exemplary satellite constellation, which corresponds to the standard ICO (Intermediate Circular Orbit) constellation, the constellation consists of two planes of five satellites each at about 10,355 km altitude and  $45^\circ$  inclination. As discussed above, the ascending nodes of the two planes are  $180^\circ$  apart at

approximately  $0^\circ$  and  $180^\circ$  longitude. The projection of the orbit planes on the surface of the earth is shown in equirectangular view in Figure 4. Based on the period of the ICO constellation, the number of satellites observed per hour at the predetermined geographic location, e.g.,  $40^\circ$  latitude, is shown in Figure 5. As can be seen in Figure 5, the satellite resources are not optimized since a maximum number of satellites is seen sporadically throughout the day.

**The paragraph beginning on Page 8 at Line 1:**

Since the desired coverage depends on the local time at the predetermined geographic location, it is desirable to have the maximum possible number of satellites providing coverage at the predetermined geographic location for about 8-12 hours per day during the middle of the day. This is achieved by tilting, or reorienting, the satellite constellation around the y axis in the equatorial plane, as shown at block 26 (block 56 of Figure 8). This process is accomplished by repeating the above simulation after rotating the parameters defining the trajectory until the desired coverage is obtained. The amount of tilting depends on the constellation. For the example given, a tilting of  $60^\circ$  is optimal, as shown in Figure 6. The orbital parameters of the tilted constellation corresponds to an inclination angle of  $69.3^\circ$  and ascending nodes of  $40.9^\circ\text{E}$  and  $139.1^\circ\text{E}$ .

**The paragraphs beginning on Page 8 at Line 24:**

Finally, command signals are generated for modifying the trajectory based on the desired amount of tilting. Since the present invention can be utilized in both designing a new satellite constellation or modifying a pre-existing satellite constellation, this step is accomplished in one of two ways. In the case in which a new satellite constellation is being designed, the tilting operation corresponds to a rotation of the original inertial coordinate system. That is, the orbital

parameters defining the trajectory is first expressed in rotation matrices. These rotation matrices are then transformed by the desired amount of tilting. A new coordinate system is then extracted from the tilted rotation matrices to obtain the new orbital parameters. The new satellite constellation with the optimum coverage is then realized by programming a computer 32 (Figure 1) in a launch vehicle 34, such as, for example, a rocket or booster, with the new orbital parameters. The satellites are then launched into space via the launch vehicle with the new orbital parameters programmed therein, as shown at block 28 (block 58 of Figure 8).

For existing satellite constellations, command signals must be generated by the satellite ground station 12 in order to achieve the desired amount of tilting, as shown at block 30 (block 60 of Figure 8). The command signals are transmitted by the satellite ground station 12 to selected satellites 14 to modify the orbital parameters so that the net change of the orbital plane is  $60^\circ$ . The command signals instruct the satellites 14 to fire-up certain thrusters (not shown) for a certain duration at a predetermined time.